



## HOME SMOKE ALARMS: WHAT DO WE KNOW?

By Marty Ahrens

### Presence and Operation

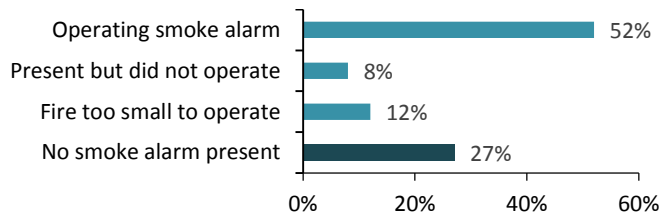
Smoke alarms provide an early warning of a fire, giving people additional escape time. In telephone surveys done for NFPA, almost all households (96%) reported having at least one smoke alarm. That still leaves roughly five million households with no smoke alarms.

Using data from the U.S. Fire Administration's National Fire Incident Reporting system (NFIRS) and NFPA's fire department survey, NFPA estimates that in 2007-2011:

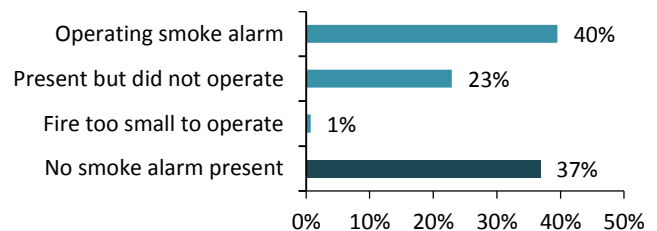
- Smoke alarms were present in roughly three-quarters (73%) of total reported home fires and associated civilian injuries (75%). Smoke alarms were present *and* operated in half (52%) of the fires
- Almost two-thirds (63%) of the deaths resulted from fires in which at least one smoke alarm was present.
- Three out of five home fire deaths were caused by fires in which no smoke alarms were present at all (37%) or in which smoke alarms were present but did not operate (23%).

### Reported Home Structure Fires and Fire Deaths by Smoke Alarm Performance: 2007-2011

#### A. Fires



#### B. Deaths

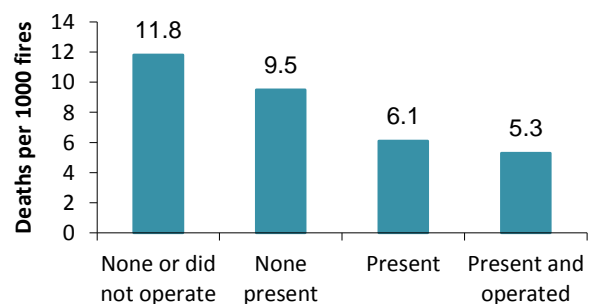


### The risk of dying in reported fires is cut in half in homes with working smoke alarms.

The risk of death from a fire in a home that had any smoke alarms (6.1 deaths per 1,000 fires) in 2007-2011, regardless of whether they were working, was 36% lower than the risk in a home with no smoke alarms at all (9.5 deaths per 1,000 fires).

The death rate in fires with working smoke alarms (5.3 per 1,000 fires) was less than half (55% lower) the risk of death from fires that did not have working smoke alarms (11.8 deaths per 1,000 fires), either because no smoke alarm was present or an alarm was present but did not operate.

### Death Rate per 1,000 Reported Home Structure Fires by Smoke Alarm Status: 2007-2011

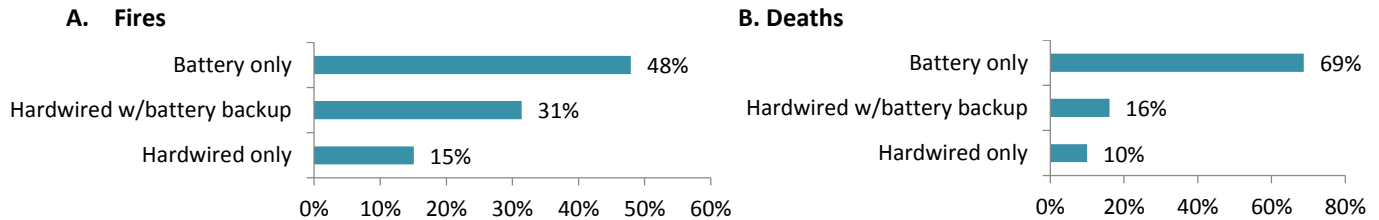


## Power source

Half (48%) of the smoke alarms present in reported home fires were powered by battery only.

- Two-thirds of home fire deaths in properties with smoke alarms present were caused by fires in which smoke alarms were powered by battery only.
- Codes such as [NFPA101®](#), [Life Safety Code®](#) have required hardwired smoke alarms in new construction for years, yet the 2011 American Housing Survey found that 30% of the homes that were four years old or less had smoke alarms powered by battery only.

**Leading Smoke Alarm Power Sources in Home Structure Fires: 2007-2011**



### In fires considered large enough to activate smoke alarms:

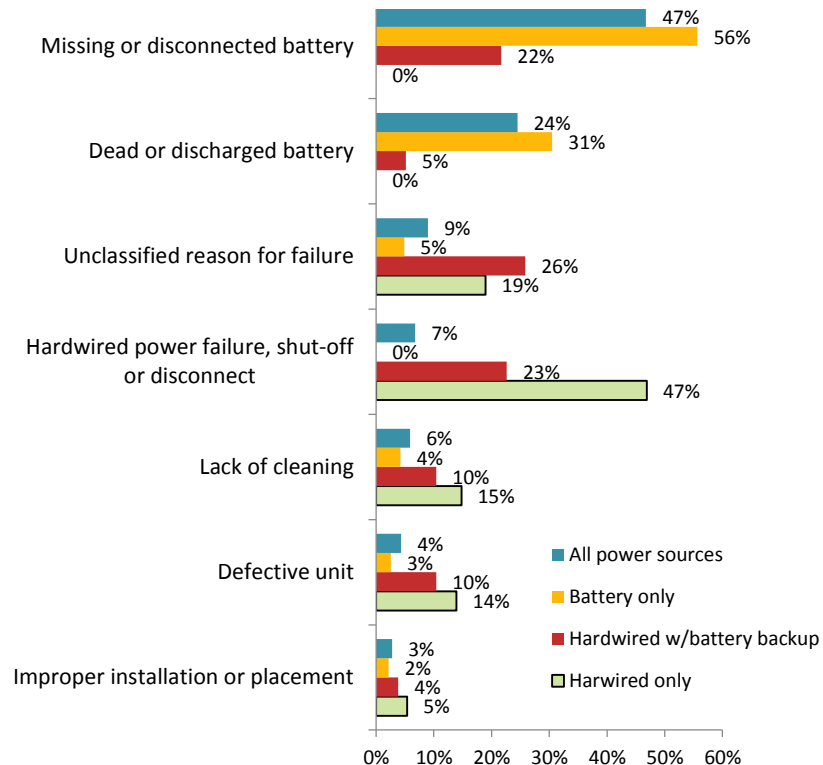
- Battery-powered alarms operated 79% of the time; and
- Hardwired smoke alarms, including those with battery backup, operated 93% of the time.

**Disconnected or non-working power sources were leading reasons for smoke alarm failures.** Reasons vary depending on the primary power source.

In more than half (56%) of reported home fires with battery-powered smoke alarm failures, batteries were missing or disconnected. Almost one-third (31%) of the smoke alarm failures were due to dead batteries.

A power-failure, shut-off or disconnect was the leading failure reason for failures of hard-wired smoke alarms (47%), and the second leading cause for hardwired with battery-back-up (23%). Other leading causes for failures of hardwired smoke alarms were unclassified reasons (19-26%), lack of cleaning (10-15%), and defective units (10-14%).

**Reason Smoke Alarms Did Not Operate in Home Structure Fires Considered Large Enough to Activate: 2007-2011**



## Fire Victims

Compared to deaths resulting from fires in which no smoke alarms were present or alarms were present but did not operate, **victims of fatal fires with working smoke alarms were:**

- More likely to have been in the room or area of origin when fatally injured (62% of victims with operating alarms) compared to the 50-52% of victims with no or no working alarms and even more likely to have been in the area of origin and involved in ignition injured (46%) compared to victims with no or no working alarms (32-37%);
- Less likely to have been sleeping when fatally injured (30% ) compared to 37-42% with no or no working alarms;
- More likely to have a physical disability (20%) compared to 8-12% with no or no working alarms;
- More likely to have been fighting the fire themselves (6% ) compared to 2% with no or no working alarms;
- More likely to have been unable to act (15%) compared to 9-11% with no or no working alarms; and
- More likely to have been at least 65 years old (35%) compared to 23-29% with no or no working alarms).

NFPA's 2014 report, [Physical Disability as a Factor in Home Fire Deaths](#), shows that when a physical disability was a factor, more than half (55%, or 220) of the victims died in fires in which smoke alarms operated.

Civilians injured in fires with working smoke alarms were more likely to have been trying to fight the fire themselves than were those injured in fires without working smoke alarms (37% of the injured with operating smoke alarms compared to 30-31% with no or no working alarms).

### Smoke alarms in the general population and in fires not reported to the fire department

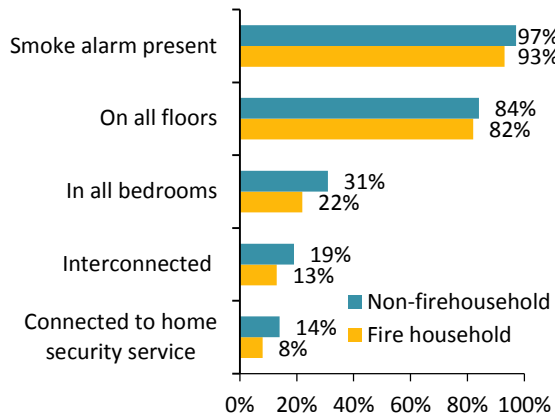
The Consumer Product Safety Commission's (CPSC's) [2004-2005 National Sample Survey of Unreported Residential Fires](#)-found that 97% of households that had fires handled the situation without calling the fire department. This telephone survey found that households that had fires were slightly less likely than those that did not to have at least one smoke alarm (93% vs. 97%).

- More than four out of five households reported having smoke alarms on all floors.
- Less than one-third (31%) of non-fire households and 22% of fire households had them in all bedrooms.
- Only one in five (19%) non-fire households had interconnected smoke alarms compared to 13% of the fire households.

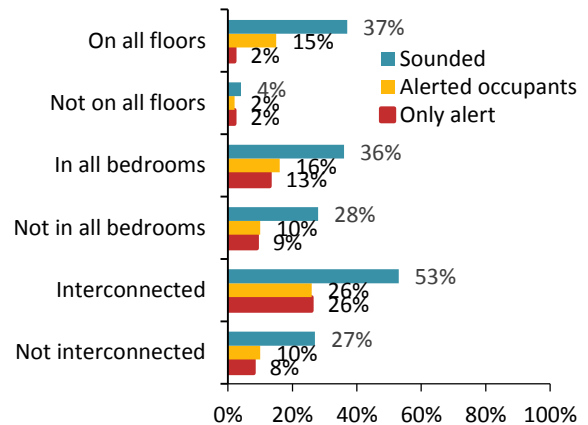
Interconnected smoke alarms were more likely to have sounded, to have alerted occupants and to have been the only alert than were single-station alarms.

- When smoke alarms were not on all floors, they were much less likely to have sounded or alerted occupants.
- When smoke alarms did not sound, it was usually because smoke did not reach the alarm.
- When they sounded but did not alert, it was generally because the occupant already knew about the fire. In other cases, the smoke alarm was not heard.

### Smoke Alarms in Fire vs. Non-Fire Households in CPSC's Survey of Unreported Residential Fires



### Smoke Alarm Performance and Effectiveness in CPSC's Survey of Unreported Residential Fires



### Audibility and sound effectiveness

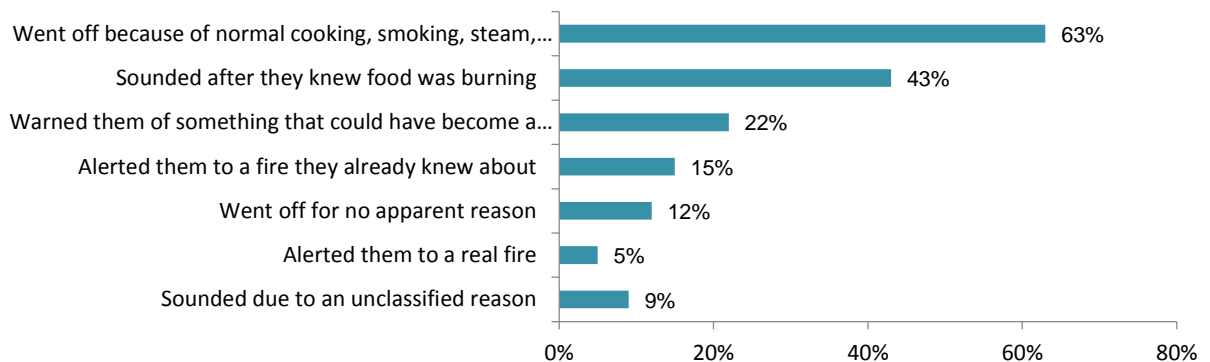
A 2005 CPSC study, [The Audibility of Smoke Alarms in Residential Homes](#), found that a closed lightweight door reduced the volume of a smoke alarm signal from another room by 10 - 20 dB. The signal was weakened by roughly 20 dB each floor it traveled.

A 2004 CPSC study, [A Review of the Sound Effectiveness of Residential Smoke Alarms](#), noted that today's smoke alarms work well waking adults who are not under the influence of alcohol or drugs or who are not sleep deprived. The authors noted that the devices may not be reliable for older adults with hearing loss. Home layout and smoke alarm locations can influence whether occupants will hear the warning. Interconnected smoke alarms provide an earlier warning.

### Unwanted activations can lead to disabled smoke alarms

Respondents in an NFPA sponsored 2010 Harris poll that had a smoke alarm go off were asked first to give one answer why it had gone off. Almost three-quarters (73%) said cooking; 8% said a low battery chirp. None mentioned a fire. They were then asked to agree or disagree with a series of statements that began with "The last time a smoke alarm sounded, it..."

### The Last Time a Smoke Alarm Sounded, It...



With 43% agreeing that it sounded after they knew food was burning, 15% saying it alerted them to a fire they already knew about, 5% saying it alerted them to a real fire and 22% agreeing that the alarm warned them of something that could become a fire, it is clear that in many activations that people don't remember as fires, the smoke alarms are operating properly and sometimes conveying important information.

**Smoke alarm performance should be considered on a continuum.**

Considering the choice as simply a fire or an unwanted alarm is an oversimplification. When someone is already aware of a situation, a sounding smoke alarm may be perceived as a nuisance. An alert to a pre-fire condition should be considered a success rather than an unwanted activation.

**Data Issues**

- The term “smoke alarm” was used throughout to include all types of fire detection found in homes. NFIRS does not distinguish between smoke alarms and smoke detectors.
- Smoke alarm presence in the general population is based on telephone surveys. CPSC’s 1993 report, [Smoke Detector Operability Survey – Report on Findings](#), is the last national survey of the general population in which researchers went to homes and tested smoke alarms.
- Version 5.0 of NFIRS requires very little information about smoke alarm presence and operating in the fires with confined structure fire incident types (confined cooking, chimney, fuel burner, incinerator, compactor, or trash) meaning that most fires were missing data on smoke alarm presence.
  - Smoke alarm presence was unknown in 94% of confined fires compared to 34% of non-confined fires.
  - Based on known data, smoke alarms were more likely to have been present (86%) and to have operated (64%) in the confined fires (86%) than in the non-confined fires (61% present, 42% operated).
  - Confined fires account for 37% of fires in one-or two-family homes and 68% in apartments or multi-family housing. Fires in properties with monitored systems may be more likely to be reported.
- NFIRS does not ask if smoke alarms were interconnected or on every floor. In multi-family home fires, it is possible to have no working alarms in the unit of origin, but working alarms elsewhere. These are hard to document. We also don’t know how big the fire was when a smoke alarm first sounded.
- Fire departments had more difficulty determining reasons when hard-wired alarms did not operate. The reason for failure was originally undetermined for half of all hardwired alarms, but only one-quarter of the battery-powered alarms. The percentage of unclassified reasons was 4-5 times as high for hardwired smoke alarms as for battery-powered alarms.
- We do not know if firefighters consider hearing loss a physical disability when completing NFIRS reports. We cannot tell how many victims did not hear a sounding smoke alarm
- We know little about the performance of aging smoke alarms.